

MULTIMEDIA



UNIVERSITY

STUDENT ID NO

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MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 2, 2018/2019

PPP0101 PRINCIPLES OF PHYSICS

(Foundation in Information Technology)

5 MARCH 2019
9.00 A.M. – 11.00 A.M.
(2 Hours)

INSTRUCTIONS TO STUDENTS

1. This question paper consists of 7 pages, including the cover page.
2. Answer all questions.
3. Write your answers in the Answer Booklet provided.
4. Show all relevant steps to obtain maximum marks.

QUESTION 1 (10 MARKS)

- a) (i) Define friction force. [1 mark]
- (ii) Define Newton's Third Law. [1 mark]
- b) If the acceleration of an object is zero, are there forces acting on the object? Explain in detail. [Hint: you may use diagram as an aid] [2 marks]
- c) The three ropes in Figure Q1(b) are tied together. Two of these ropes are anchored to walls at roof, to support the load of 15 kg. The system is at rest.
- (i) Identify the forces acting on the system by sketching a free-body diagram. [1.5 marks]
- (ii) Find the tension forces acting in the ropes. [2.5 marks]

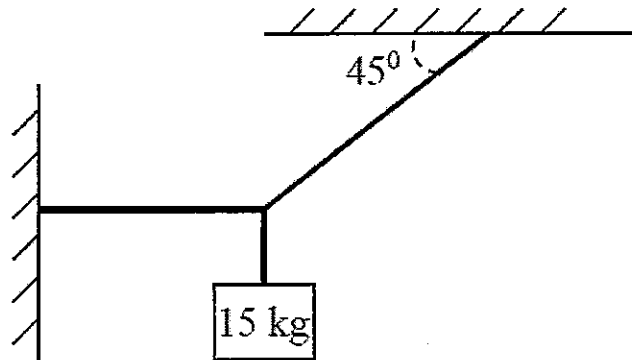


Figure Q1(b)

- d) A 20.0kg block rests on a horizontal table. The coefficient of kinetic friction between the block and table is 0.15. What force is required to pull the block at constant speed if a horizontal rope is attached ? [2 marks]

Continued...

QUESTION 2 (10 MARKS)

- a) A 0.70 kg mass is undergoing a Simple Harmonic Motion with a displacement as a function of time given by

$$x(t) = (4.50\text{cm})\cos[(5.35\text{rad/s})t - \frac{3\pi}{2}]$$

Determine

- (i) the maximum displacement. [0.5 mark]
 - (ii) the frequency. [1 mark]
 - (iii) the maximum speed and the maximum acceleration. [3 marks]
 - (iv) the speed and acceleration of the mass at $t = 2.0$ s [3 marks]
- b) Peter pulls a simple pendulum 0.755 m long to the side through an angle of 5.50° and release it. Determine
- (i) the time needed for the pendulum bob to reach its highest speed. [2 marks]
 - (ii) the time needed for the pendulum bob to reach its highest speed, if the pendulum is released at an angle of 2.45° instead of 5.50° . [0.5 mark]

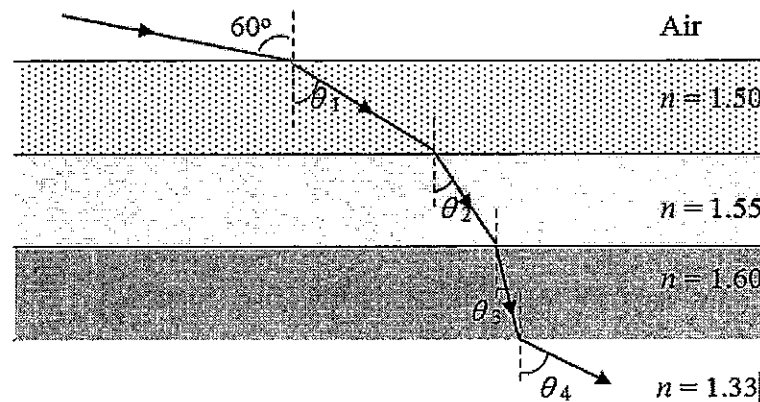
QUESTION 3 (15 MARKS)

- a) Define and sketch the diagram for the following:
- (i) transverse wave [2 marks]
 - (ii) longitudinal wave [2 marks]
- b) A transverse traveling wave on a cord is represented by $x = 0.22\sin(5.6x + 34t)$, where x is in meters and t is in seconds. For this wave, determine
- (i) the wavelength. [1.5 marks]
 - (ii) the frequency. [1.5 marks]
 - (iii) velocity (magnitude and direction). [2 marks]
 - (iv) maximum and minimum speeds of particles of the cord. [2 marks]
- c) The intensity of a whisper at one meter is $I = 1.0 \times 10^{-10} \text{ W/m}^2$. What is the sound intensity of a whisper at a distance of 2.0 m, in W/m^2 ? What is the corresponding sound intensity level in dB of the whisper at distance of 2.0 m? [2 marks]
- d) Define Doppler Effect and provide one (1) example in daily life. [2 marks]

Continued...

QUESTION 4 (15 MARKS)

- a) A pair of narrow, parallel slits separated by $6.75 \mu\text{m}$ is illuminated by the green component from a mercury vapor lamp ($\lambda = 445 \text{ nm}$). The interference pattern is observed on a screen 2.30 m from the plane of the parallel slits. Calculate the
- distance from the central maximum to the first bright region on either side of the central maximum, [2 marks]
 - distance between the first and second dark bands in the interference pattern, and [2 marks]
 - number of bright fringes will be produced on either side of the central maximum. (Hint: The pattern will display an isosceles triangle) [2 marks]
- b) Calculate the angles θ_1 , θ_2 , θ_3 , and θ_4 in **Figure Q4(b)** below. [6 marks]

**Figure Q4(b)**

- c) A diffraction grating has 13500 lines/cm. A beam of light of wavelength 330 nm is incident normally on the grating. Determine the angular position of the second order maxima. [3 marks]

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APPENDIXES

LIST OF PHYSICAL CONSTANTS

Electron mass,	m_e	=	$9.11 \times 10^{-31} \text{ kg}$
Proton mass,	m_p	=	$1.67 \times 10^{-27} \text{ kg}$
Neutron mass,	m_n	=	$1.67 \times 10^{-27} \text{ kg}$
Magnitude of the electron charge,	e	=	$1.602 \times 10^{-19} \text{ C}$
Universal gravitational constant,	G	=	$6.67 \times 10^{-11} \text{ N.m}^2 \text{ kg}^{-2}$
Universal gas constant,	R	=	8.314 J/K.mol
Hydrogen ground state,	E_o	=	13.6 eV
Boltzmann's constant,	k_B	=	$1.38 \times 10^{-23} \text{ J/K}$
Compton wavelength,	λ_c	=	$2.426 \times 10^{-12} \text{ m}$
Planck's constant,	h	=	$6.63 \times 10^{-34} \text{ J.s}$
		=	$4.14 \times 10^{-15} \text{ eV.s}$
Speed of light in vacuum,	c	=	$3.0 \times 10^8 \text{ m/s}$
Rydberg constant,	R_H	=	$1.097 \times 10^7 \text{ m}^{-1}$
Acceleration due to gravity,	g	=	9.81 m s^{-2}
Unified atomic mass unit,	1 u	=	931.5 MeV/c^2
		=	$1.66 \times 10^{-27} \text{ kg}$
1 electron volt,	1 eV	=	$1.60 \times 10^{-19} \text{ J}$
Avogadro's number,	N_A	=	$6.023 \times 10^{23} \text{ mol}^{-1}$
Threshold of intensity of hearing,	I_o	=	$1.0 \times 10^{-12} \text{ W m}^{-2}$
Coulomb constant,	$k = \frac{1}{4\pi\epsilon_o}$	=	$9.0 \times 10^9 \text{ Nm}^2 \text{ C}^{-2}$
Permittivity of free space,	ϵ_o	=	$8.85 \times 10^{-12} \text{ C}^2/\text{N.m}^{-2}$
Permeability of free space,	μ_o	=	$4\pi \times 10^{-7} \text{ (T.m)/A}$
1 atmosphere pressure,	1 atm	=	$1.0 \times 10^5 \text{ N/m}^2$
		=	$1.0 \times 10^5 \text{ Pa}$
Earth: Mass,	M_E	=	$5.97 \times 10^{24} \text{ kg}$
Radius (mean),	R_E	=	$6.38 \times 10^3 \text{ km}$
Moon: Mass,	M_M	=	$7.35 \times 10^{22} \text{ kg}$
Radius (mean),	R_M	=	$1.74 \times 10^3 \text{ km}$
Sun: Mass,	M_S	=	$1.99 \times 10^{30} \text{ kg}$
Radius (mean),	R_S	=	$6.96 \times 10^5 \text{ km}$
Earth-Sun distance (mean),		=	$149.6 \times 10^6 \text{ km}$
Earth-Moon distance (mean),		=	$384 \times 10^3 \text{ km}$

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LIST OF FORMULA

Differential Rule	Trigonometric Identity		
$y = kx^n$ $\frac{dy}{dx} = knx^{n-1}$	$\sin \theta = \frac{\text{opposite}}{\text{hypotenuse}}$ $\tan \theta = \frac{\text{opposite}}{\text{adjacent}}$	$\cos \theta = \frac{\text{adjacent}}{\text{hypotenuse}}$ $\sin \alpha + \sin \beta = 2 \cos \left(\frac{\alpha - \beta}{2} \right) \sin \left(\frac{\alpha + \beta}{2} \right)$ $\sin(\alpha - \beta) + \sin(\alpha + \beta) = 2 \sin \alpha \cos \beta$	
NEWTONIAN MECHANICS			
$v = \frac{\Delta x}{\Delta t}$ $v^2 = v_o^2 + 2a(x - x_o)$ $v = v_o + gt$ $W = Fs \cos \theta$ $f_k = \mu_k F_N$ $m_1 u_1 + m_2 u_2 = m_1 v_1 + m_2 v_2$ $K = \frac{1}{2} mv^2$ $v_{\text{circular}} = \frac{2\pi r}{T}$ $T^2 = K_s r^3$ Spring with mass, $\omega = \sqrt{\frac{k}{m}}$	$a = \frac{\Delta v}{\Delta t}$ $x - x_o = \left(\frac{v_o + v}{2} \right) t$ $y - y_o = v_o t + \frac{1}{2} gt^2$ $W = mg$ $p = mv$ $m_1 u_1 + m_2 u_2 = (m_1 + m_2) v$ $PE_s = \frac{1}{2} kx^2$ $a_c = \frac{v^2}{r}$ $T_s = 2\pi \sqrt{\frac{m}{k}}$ Simple pendulum, $\omega = \sqrt{\frac{g}{l}}$	$v = v_o + at$ $v^2 = v_o^2 + 2g(y - y_o)$ $\sum F = F_{\text{net}} = ma$ $\sum F = \frac{\Delta p}{\Delta t}$ $F_s = -kx$ $F_g = G \frac{m_1 m_2}{r^2}$ $T_p = 2\pi \sqrt{\frac{l}{g}}$ Sine Wave: $v = \omega A \cos \omega t$ $a = -\omega^2 A \sin \omega t$	$x - x_o = v_o t + \frac{1}{2} at^2$ $y - y_o = \left(\frac{v_o + v}{2} \right) t$ $f_s \leq \mu_s F_N$ $P = \frac{W}{t} = \frac{E}{t} = \frac{Fd}{t} = F\bar{v}$ $PE_G = mgy$ $U_g = -G \frac{m_1 m_2}{r}$ $T = \frac{2\pi}{\omega} = \frac{1}{f}$ Cosine Wave: $x = A \cos \omega t$ $v = -\omega A \sin \omega t$ $a = -\omega^2 A \cos \omega t$

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WAVES AND OPTICS

$$v = f\lambda$$

$$\omega = 2\pi f$$

$$n = \frac{c}{v}$$

$$n_1 \sin \theta_1 = n_2 \sin \theta_2$$

$$\sin \theta_c = \frac{n_2}{n_1}$$

$$\frac{1}{f} = \frac{1}{d_o} + \frac{1}{d_i}$$

$$M = -\frac{d_i}{d_o} = \frac{h_i}{h_o}$$

$$f = \frac{R}{2}$$

$$d \sin \theta_{\max} = m\lambda$$

$$a \sin \theta_{\min} = m\lambda$$

$$d \sin \theta_{\min} = (m + \frac{1}{2})\lambda$$

$$y_{\text{bright}} = \frac{m\lambda L}{d}$$

$$y_{\text{dark}} = (m + \frac{1}{2}) \frac{\lambda L}{d}$$

$$I = \frac{P}{A}$$

$$\beta = 10 \log_{10} \frac{I}{I_o}$$

$$f' = f \left(\frac{v \pm v_o}{v \mp v_s} \right)$$

$$y(x, t) = A \sin(kx \pm \omega t + \phi)$$

Wave Type:

$$y(x, t) = 2A \cos \left(\frac{\phi}{2} \right) \sin \left(kx - \omega t - \frac{\phi}{2} \right)$$

$$y(x, t) = 2A \sin kx \cos \omega t$$